Significant scientific achievements of the project DST/TSG/PT/2008/25

I. A nanocomposite comprising of multiwalled carbon nanotubes (MWCNT) embedded in ferroelectric Poly (vinylidene fluoride) PVDF polymer matrix is examined for electric field induced transport modulation. The pulsed laser deposition (PLD) grown thin films of the nanocomposite with different MWCNT content were characterized. When used as a channel layer in a field effect transistor configuration, a strong electric field modulation of the transport was realized just below the percolation threshold. We believe that this nanocomposite non-percolating channel concept can provide several opportunities for FET devices for organic electronics.

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II. The fabrication of high quality thin films of poly (vinylidene fluoride) embedded with multiwalled carbon nanotubes using pulsed laser deposition technique is reported. The prepared films were characterized for structural, morphology and dielectric properties. The morphology analysis revealed uniform dispersion of multiwalled carbon nanotubes throughout the polymer matrix. X-ray diffraction results suggested that the poly (vinylidene fluoride) film is in amorphous phase while addition of multiwalled carbon nanotubes showed presence of crystalline peaks in the nanocomposites films. It was interesting to note that the nanocomposite films exhibits significant enhancement of the ferroelectric β-phase as evidenced by the X-ray diffraction and Fourier transform infrared spectroscopy results. The dielectric analysis shows a remarkable enhancement in the dielectric permittivity of nanocomposites with lower loss and conductivity level. The results can be attributed to the formation of minicapacitor network and relatively higher percolation threshold in the nanocomposites.

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III. PVDF nanofibers are prepared using electrospinning technique. The effect of addition of hydrated salt Nickel chloride hexahydrate ($NiCl_2.6H_2O$) on the phase formation is examined. Addition of hydrated salt (NC) is found to enhance the polar β phase by about 30%. The peak to peak piezo-voltage generated for PVDF NC is almost 0.762 V, a factor of 3 higher than that for PVDF. The fiber mats exhibit a significantly enhanced dynamic strain sensor response. The voltage generated per unit micro strain developed during the free vibration test for PVDF was 0.119 mV whereas it was 0.548 mV for PVDF NC, exhibiting a non-linearly enhanced performance vis a vis the increase in the β phase component.

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Apart from these published results some work on electrospinning of nanocomposites of PVDF with ZnO and their characterization, preparation of high dielectric constant PVDF-Si_3N_4 nanocomposites and the use of this composite as a dielectric layer in a FET has been successfully demonstrated